

Applicant: Apichatachutapan et al.
Serial No.: 10/607,555
Group Art Unit: 1711

REMARKS

Claims 1-12, 14-38, and 40-46 remain in the subject application with claims 1 and 32 in independent form. Claims 1, 20, and 32 have been amended. Claims 13 and 39 have been cancelled and claims 45-46 have been added. There is full support in the specification as originally filed for these amendments and additional claims. Accordingly, no new matter has been introduced.

Applicant is submitting a petition for a one-month extension of time which is accompanied by the fee required under 37 C.F.R. §1.17(a)(1). The mailing date of the Office Action was December 14, 2004 and the three-month response date was March 14, 2005. The petition seeks to extend to period for reply to April 14, 2005 and the subject amendment is being filed during this extended period.

Applicant is also submitting a Supplemental Information Disclosure Statement (IDS) under 37 C.F.R. §1.97(c)(2) which is accompanied by the fee required under 37 C.F.R. §1.17(p). The submission of this Supplemental IDS resulted from a search related to a related foreign patent application filed under the Patent Cooperation Treaty, as well as references uncovered in related United States patent applications before the Examiner. It is believed that the references uncovered are duplicative of the references that have been previously cited in the IDS originally filed with the subject application. Specifically, these references are directed toward using a chain extender in forming either of a microcellular elastomeric polyurethane foam or a polyisocyanurate foam, not a viscoelastic polyurethane foam. Applicant is not claiming to have invented chain extenders in and of themselves; however, Applicant is claiming to have been the first to successfully incorporate the chain extender in the claimed amount into viscoelastic polyurethane foams. Such inclusion of the chain extender provides greater flexibility in

producing the viscoelastic polyurethane foam with a desired glass transition temperature that is closer to a use temperature of the viscoelastic polyurethane foam.

As discussed in the “Background of the Invention” section of the subject application as originally filed, related art viscoelastic polyurethane foams have a narrow processing window to arrive at a desired glass transition temperature (T_g) that coincides with a use temperature of the viscoelastic polyurethane foam. Most related art viscoelastic polyurethane foams have a single T_g near 0 °C which severely limits the uses of the viscoelastic polyurethane foams. The subject invention has overcome such a problem by allowing the T_g to be manipulated to accommodate various use temperatures while also providing characteristics that are desired for viscoelastic polyurethane foam.

Claims 1-44 stand provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-58 of copending Application No. 10/606,825 and claims 1-41 of copending Application No. 10/916,241. Applicant submits herewith a timely filed Terminal Disclaimer in compliance with 37 C.F.R. §1.321(c) which is accompanied by the fee required under 37 C.F.R. §1.20(d). It is believed that the Terminal Disclaimer overcomes these provisional double patenting rejections.

As well known to those skilled in the art (and as also disclosed in Kageoka et al. at col. 5, lines 23-30), the functionality and hydroxyl number of a polyol can be used to determine the molecular weight in accordance with the following formula:

$$MolecularWeight = \frac{56,100 * f}{OH\#}$$

where *f* is the functionality of the polyol; and
OH# is the hydroxyl number (mg KOH/g).

Claims 45-46 have been added and paragraph [0029] of the specification as originally filed has been amended. In paragraph [0029], the chain extender is described as having a molecular weight of less than 1000, preferably from 25 to 250, and more preferably less than 100. Further, in paragraph [0030], the chain extender is described as having two isocyanate reactive groups. With knowledge of the molecular weight and the functionality for the chain extender, a person of ordinary skill in the art, relying on the above-referenced mathematical formulation can easily deduce the hydroxyl number that is now incorporated into the specification and the claims.

The preferred molecular weight of the chain extender is from 25 to 250. The corresponding hydroxyl numbers can be calculated using the above formula. At a molecular weight of 25 and a functionality of 2, the hydroxyl number is $(56,100 \times 2)/25$, or 4,488 mg KOH/g. At a molecular weight of 250 and a functionality of 2, the hydroxyl number is $(56,100 \times 2)/250$, or 448.8 mg KOH/g. Therefore, the hydroxyl number is preferably more than 450 mg KOH/g. Claims 59-61 claim the chain extender having a hydroxyl number of greater than 450 mg KOH/g and paragraph [0029] has been amended to recite that the chain extender has the hydroxyl number greater than 450 mg KOH/g. There is full support in the specification as originally filed for these amendments and new claims. Accordingly, no new matter has been introduced.

Claims 1-44 stand rejected under 35 U.S.C. §102(b) as being anticipated by Kageoka et al. (United States Patent No. 6,204,300) and EP 0,934,962, each taken individually. The '300 patent and EP '962 both claim priority to JP 10-026149 and JP 10-246627. Therefore, they are deemed to be equivalents and will be referred to collectively hereinafter as Kageoka et al. The Examiner states that Kageoka et al. discloses polyurethane foams formed from isocyanates and blends of polyols as claimed.

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Further, the Examiner contends that the polyols of Kageoka et al. meet the function of the claimed chain extender in the subject application.

In the alternative, claims 1-44 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Kageoka et al. in view of Khanna (United States Patent No. 4,209,593), Kelly et al. (United States Patent No. 4,670,477), and Nishida et al. (United States Patent No. 6,136,879). The Examiner relies on Khanna for disclosing use of cross-linkers, i.e., a chain extender, in soft flexible foams and contends that it would have been obvious to employ the cross-linkers in preparations of Kageoka et al. The Examiner relies on Kelly et al. for disclosing cell openers and Nishida et al. for disclosing monols.

Claims 1 and 32 have been amended to recite that the chain extender has a molecular weight of from 25 to 250, which was previously set forth in now cancelled claims 13 and 39. Since claims 13 and 39 also stand rejected under 35 U.S.C. §102(b), or in the alternative under 35 U.S.C. §103(a), Applicant respectfully traverses these rejections at the threshold of original dependent claims 13 and 39.

The subject invention claims a viscoelastic polyurethane foam having a density of greater than two and a half pounds per cubic foot and a composition and method for forming the same. The viscoelastic polyurethane foam comprises a reaction product of an isocyanate component substantially free of toluene diisocyanate, an isocyanate-reactive blend, and a chain extender.

The isocyanate-reactive blend comprises a first isocyanate-reactive component and a second isocyanate-reactive component. The first isocyanate-reactive component has a weight-average molecular weight of from 2500 to 4500, a hydroxyl number of from 30 to 50, and comprises at least 60 parts by weight of ethylene oxide based on 100 parts by weight of the first isocyanate-reactive component. The second isocyanate-reactive

component has a weight-average molecular weight of from 1000 to 6000, a hydroxyl number of from 20 to 500, and comprises at most 30 parts by weight of ethylene oxide based on 100 parts by weight of the second isocyanate-reactive component. The first isocyanate-reactive component is used in an amount of from 40 to 75 parts by weight and the second isocyanate-reactive component is used in an amount of from 25 to 60 parts by weight of based on 100 parts by weight of the isocyanate-reactive blend.

As claimed, the chain extender has a backbone chain with from two to eight carbon atoms and a weight-average molecular weight of from 25 to 250. As also claimed, the chain extender is used in an amount of from 5 to 50 parts by weight based on 100 parts by weight of the viscoelastic polyurethane foam and the resultant viscoelastic polyurethane foam has a glass transition temperature of from 5 to 65 degrees Celsius and a tan delta peak of from 0.40 to 1.75.

It is the novel and unique combination of the chain extender in the amounts of from 5 to 50 parts by weight and the isocyanate-reactive blend that permits adjustment of the Tg for the viscoelastic polyurethane foam. As discussed in paragraph [0031] of the specification as originally filed, "the chain extender and the isocyanate component react to form urethane hard segments within the viscoelastic polyurethane foam that are incorporated into the soft segment phase and raise the soft segment Tg. The soft segment phase is typically the isocyanate-reactive component. The incorporation of the chain extender in the amounts claimed allows adjustment of Tg over a wide range of temperatures, independent of a density of the viscoelastic polyurethane foam, which was not previously possible." The subject invention also provides flexibility to produce viscoelastic polyurethane foams with a wide range of Tg's, by adjusting the chain

extender level, which further broadens the applications of the resultant viscoelastic polyurethane foam.

On the other hand, Kageoka et al. discloses a low resilience urethane foam that is formed from a) a polyol, b) a polyisocyanate, c) a catalyst, and d) a blowing agent. The polyol (a) is at least one polyol selected from the group consisting of polyoxyalkylene polyol, vinyl polymer-containing polyoxyalkylene polyol, polyester polyol, and polyoxyalkylene polyester block copolymer polyol (*see col. 3, lines 24-28*). It is appreciated by those skilled in the art that such polyols used as a backbone resin for foam are not chain extenders. Instead, these polyols typically have a carbon chain of more than 2 to 8 carbon atoms and a molecular weight significantly higher than 250.

Kageoka et al. further defines each type of polyol listed above. Polyalkylene polyols include alkylene oxide added to initiators, such as water, alcohol, amine and ammonia. Vinyl polymer-containing polyoxyalkylene polyols have vinyl monomers polymerized and stably dispersed in the polyoxyalkylene polyols. Polyester polyols are obtained by condensation polymerization compounds having two or more hydroxyl groups and compounds having two or more carboxyl groups. Polyoxyalkylene polyester block copolymer polyols have the structure of polyoxyalkylene polyol blocked by a polyester chain (*see col. 3, lines 29-67, and col. 4, lines 1-30*).

Further, Kageoka et al. discloses that the polyol (a) includes a combination of a first polyol (a-1) and a second polyol (a-2). The first polyol (a-1) is present in an amount of from 32-80 weight percent and the second polyol (a-2) is present in an amount of from 20-68 weight percent. The first polyol (a-1) has an average functionality of from 1.5 to 4.5 and a hydroxyl value, or number, from 20 to 70 mg KOH/g. The second polyol (a-2)

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has an average functionality of from 1.5 to 4.5 and a hydroxyl value, or number, from 140 to 300 mg KOH/g (see col. 4, lines 31-67).

The functionality, hydroxyl number, and molecular weight can be calculated according to the well known formula listed above. The following tables illustrate the calculated molecular weight of the first polyol (a-1) and the second polyol (a-2) based upon possible combinations of the functionality and hydroxyl number.

Polyol (a-1)		
Functionality	Hydroxyl Number (mg KOH/g)	Molecular Weight
1.5	20.0	4,207.5
1.5	70.0	1,202.1
2.0	20.0	5,610.0
2.0	70.0	1,602.9
2.5	20.0	7,012.5
2.5	70.0	2,003.6
3.0	20.0	8,415.0
3.0	70.0	2,404.3
3.5	20.0	9,817.5
3.5	70.0	2,805.0
4.0	20.0	11,220.0
4.0	70.0	3,205.7
4.5	20.0	12,622.5
4.5	70.0	3,606.4

Polyol (a-2)		
Functionality	Hydroxyl Number (mg KOH/g)	Molecular Weight
1.5	140.0	601.1
1.5	300.0	280.5
2.0	140.0	801.4
2.0	300.0	374.0
2.5	140.0	1,001.8
2.5	300.0	467.5
3.0	140.0	1,202.1

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3.0	300.0	561.0
3.5	140.0	1,402.5
3.5	300.0	654.5
4.0	140.0	1,602.9
4.0	300.0	748.0
4.5	140.0	1,803.2
4.5	300.0	841.5

The first polyol (a-1) has a molecular weight range of from 1,202.1 to 12,622.5 and the second polyol (a-2) has a molecular weight range of from 280.5 to 1,803.2. Each of these ranges is significantly higher than the range of molecular weight for the possible chain extenders that are used with the subject invention.

Based upon the foregoing and contrary to the Examiner's contentions, Kageoka et al. does not disclose a chain extender having a molecular weight of from 25 to 250 for incorporation into a viscoelastic polyurethane foam as claimed. Kageoka et al. also fails to disclose the combination of the chain extender in the amounts claimed and an isocyanate-reactive blend to produce the desired viscoelastic properties. Therefore, Kageoka et al. does not disclose each and every element as claimed. In other words, if the polyols of Kageoka et al. are compared to the isocyanate-reactive blend of the subject application as claimed, Kageoka et al. fails to disclose an additional component satisfying the elements of the chain extender as claimed. Applicant respectfully submits that the 35 U.S.C. §102(b) rejection is overcome and that claims 1-12, 14-38, and 40-46 are believed to be allowable.

Turning now to the 35 U.S.C. §103(a) rejection, there is no suggestion or motivation to combine the teachings of the other cited references, including Khanna, with Kageoka et al. to arrive at the viscoelastic polyurethane foam as claimed. As discussed in the specification of the subject application, various physical properties determine whether

a foam is viscoelastic, such as the glass transition temperature of the foam and the peak tan delta. Peak tan delta indicates the ability of the foam to dissipate energy during a compression cycle and is related to a recovery time of the foam. These properties are determined through a dynamic mechanical thermal analysis (DMTA). The glass transition temperature of typical viscoelastic polyurethane foam is typically about 5 to 50 degrees Celsius and the peak tan delta is about 0.3 to 1.8. The glass transition temperature and the peak tan delta result from vitrification of a soft segment phase of the foam. Vitrification manipulates the structure and composition of the soft segment phase so that the glass transition temperature approximately coincides with a use temperature of the foam, thereby maximizing the viscoelastic nature of the foam.

Kageoka et al. is directed toward viscoelastic polyurethane foam. In contrast, the cited references, including Khanna, are all directed toward non-viscoelastic foams that do not have the properties described above that are characteristic of viscoelastic foam. Specifically, Khanna is directed toward semi-flexible foam, Kelly et al. is directed toward a reticulated, open-cell polyurethane foam, and Nishida et al is directed toward a soft, or flexible, polyurethane foam.

The characteristic properties of viscoelastic polyurethane foam are not present in these other polyurethane foams and, as such, one skilled in the art would not look to non-viscoelastic foams for a teaching to utilize a chain extender in the amounts claimed to modify a Tg. While non-viscoelastic polyurethane foams may use chain extenders to effect the modulus of the foam, non-viscoelastic polyurethane foams have Tg's well below or above the respective use temperature of the foam.

It would be undesirable to have a Tg near the use temperature for non-viscoelastic foam. For example, a rigid polyurethane foam requires dimensional stability and should

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therefore not undergo transitions at the use temperature. Similarly, flexible and semi-flexible polyurethane foams must have sufficient resilience to support a fast recovery. If the T_g was near ambient temperatures, the flexible and semi-flexible polyurethane foams may not perform as required. For example, non-viscoelastic polyurethane foam used for shoe soles must have sufficient resilience to recover between steps while walking or running. If the T_g for the shoe sole was near ambient temperature, the shoe sole would not recover quickly enough while walking or running and would be rendered useless for such applications.

Therefore, there is no teaching or suggestion of using the claimed amounts of the chain extender and the isocyanate-reactive blend to adjust the T_g's of the viscoelastic polyurethane foam to coincide with use temperatures of the foam. Thus, there can be no suggestion or motivation to combine the teachings of the cited references, especially Khanna, with Kageoka et al. and claims 1-12, 14-38, and 40-46 are believed to be allowable over any §103 rejection.

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Accordingly, it is respectfully submitted that the Application, as amended, is now presented in condition for allowance, which allowance is respectfully solicited. Applicant believes that no fees are due, however, if any become required, the Commissioner is hereby authorized to charge any additional fees or credit any overpayments to Deposit Account 08-2789.

Respectfully submitted

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4/14/05

Date



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CERTIFICATE OF EXPRESS MAILING

I hereby certify that this Amendment, One-Month Extension of Time, Supplemental Information Disclosure Statement, Forms PTO/SB/08A, PTO/SB/08B, Terminal Disclaimer and fees for United States Patent Application Serial Number 10/607,555 filed June 26, 2003 are being deposited with the United States Postal Service as Express Mail, Label No. EV618892980US postage prepaid, in an envelope addressed to, Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on April 14, 2005.



Sandra Barry